



## Inflation in the Costs of Building Aircraft Carriers

The Department of Defense (DoD) submitted to the Congress the Navy's 2016 shipbuilding plan for fiscal years 2016 to 2045 in April 2015.<sup>1</sup> As detailed in that plan, the Navy intends to purchase six CVN-78 Gerald R. Ford class aircraft carriers over the 2016–2045 period. Construction of the lead ship, the *Gerald R. Ford*, is nearly finished. The next carrier in the class will be the *John F. Kennedy* (CVN-79). Funding for that ship began in 2007, the Congress officially authorized its construction in 2013, and appropriations for it are expected to be complete by 2018.

In 2006, the Congress placed a limitation (hereafter referred to as a cost cap) of \$8.1 billion on the amount the Navy could spend on the second and following ships in the Ford class. That amount could be adjusted to account for economic inflation and other factors. (The legislation did not clearly define “economic inflation,” but the Navy has interpreted it to mean increases in the prices of labor and materials after 2006 for the carrier program.) As a result of such adjustments, the Navy—in 2013—raised the cost cap to \$11.5 billion.

Actual inflation in the prices of labor and materials was the most important contributor to the rise in the cost cap, accounting for \$2.5 billion of the \$3.4 billion increase, according to analyses by both the Navy and the Congressional Budget Office. From 2007 to 2013, economic inflation specific to the carrier program totaled 31 percent, an average annual rate of 3.96 percent, slightly less than the 4.18 percent rate the Navy had projected in 2006. This CBO report examines the Navy's inflation estimates, as directed by the conference report

for the National Defense Authorization Act (NDAA) for Fiscal Year 2016 (S. 1356, which became Public Law 114-92).

### The Limitation on Costs for Follow-On Ships of the Ford Class

In the John Warner National Defense Authorization Act for Fiscal Year 2007 (P.L. 109-364), which was signed into law in October 2006, the Congress stated that the Navy could not spend more than \$8.1 billion per ship to build Ford class aircraft carriers.<sup>2</sup> According to the act, the cost cap could be adjusted for one or more of the following reasons:

- Increases or decreases in costs attributable to economic inflation after September 30, 2006;
- Increases or decreases in costs attributable to compliance with changes in federal, state, or local laws enacted after September 30, 2006;
- Outfitting costs and postdelivery costs incurred for a given ship;
- Increases or decreases in costs attributable to the installation of new technology in a given ship, as compared with the baseline technology established in the program acquisition estimate that was approved in December 2005;
- Increases or decreases in nonrecurring design and engineering costs attributable to achieving compliance with the cost cap; and

1. Department of the Navy, *Report to Congress on the Annual Long-Range Plan for Construction of Naval Vessels for Fiscal Year 2016* (March 2015), <http://tinyurl.com/ocrqtfc>.

2. For the lead ship of the class, the Congress imposed a cost cap of \$10.5 billion, which was ultimately raised to \$12.9 billion.

- Increases or decreases in costs required to correct deficiencies that could affect the safety of the ship and its personnel or otherwise prevent the ship from operating safely and prevent the crew certifications.

On May 6, 2013, more than six years after the original cost cap was established in law, the Secretary of the Navy sent a letter to the Congress stating that the service was using those provisions to increase the cost cap for follow-on ships to \$11.5 billion in nominal dollars, a total increase of \$3.4 billion.<sup>3</sup> That represented a change from the President's fiscal year 2006 budget to the fiscal year 2013 budget.

### How the Navy Adjusted the Cost Cap

According to the Navy, \$2.5 billion of that increase in the cost cap was attributable to economic inflation. Most of the remainder was attributable to the added impact of inflation stemming from changes in DoD's projections of the timing of outlays for the construction of carriers and from changes in the construction schedule for the second ship, as well as to some redesign aimed at lowering costs of the second and subsequent carriers in the class.

The combined effect of those three changes increased the cost cap by \$3.1 billion, to \$11.2 billion. CBO also looked at a fourth element that increased the costs of the carrier but was not related to inflation: changing the design of the ship to reduce its cost. The design changes increased the cost cap by another \$0.3 billion.<sup>4</sup>

### Economic Inflation

The Navy chose to interpret "economic inflation" in the legislative language as the increase in the prices of labor and materials in the carrier shipbuilding industry. CBO used that interpretation to examine how the Navy did its analysis; other interpretations, such as the growth in

prices in the overall economy, might produce smaller increases in the cost cap. The Navy provided CBO with historical inflation rates for that industry, which averaged 3.96 percent between 2007 and 2013 and compounded to a cumulative increase of about 31 percent. Thus, that component alone would have allowed the Navy to increase the cost cap of \$8.1 billion by \$2.5 billion, to \$10.6 billion.

### Timing of Outlays

A smaller adjustment to the cap resulted from a minor change that DoD made to its internal budgetary guidance in 2013 about how the services should convert budget authority into a stream of outlays. That change reflects DoD's expectation that a larger proportion of outlays for shipbuilding in general would be spent in the later years of construction, and thereby would be subject to inflation for a longer period. The added costs of inflation associated with that change resulted in an increase of \$43 million in the funding cap for the second ship in the Ford class, the CVN-79.

### Schedule for Ship Construction

A third adjustment resulted from a specific change in the schedule for the second ship of the class, and therefore its funding profile. (Under that schedule change, the second ship will be completed two years later than the Navy previously planned.) Under the original construction plan, the Navy expected that outlays for building the second ship would occur between 2007 and 2020, including outlays for advance procurement. The Navy revised that schedule as part of its 2014 construction plan (which is consistent with the service's budget for fiscal year 2013) and now expects the outlays to occur over two more years, extending the period through 2022 (see Figure 1). That schedule change would result in additional costs from inflation, which the Navy calculated (and CBO confirmed) would result in an increase of \$495 million.

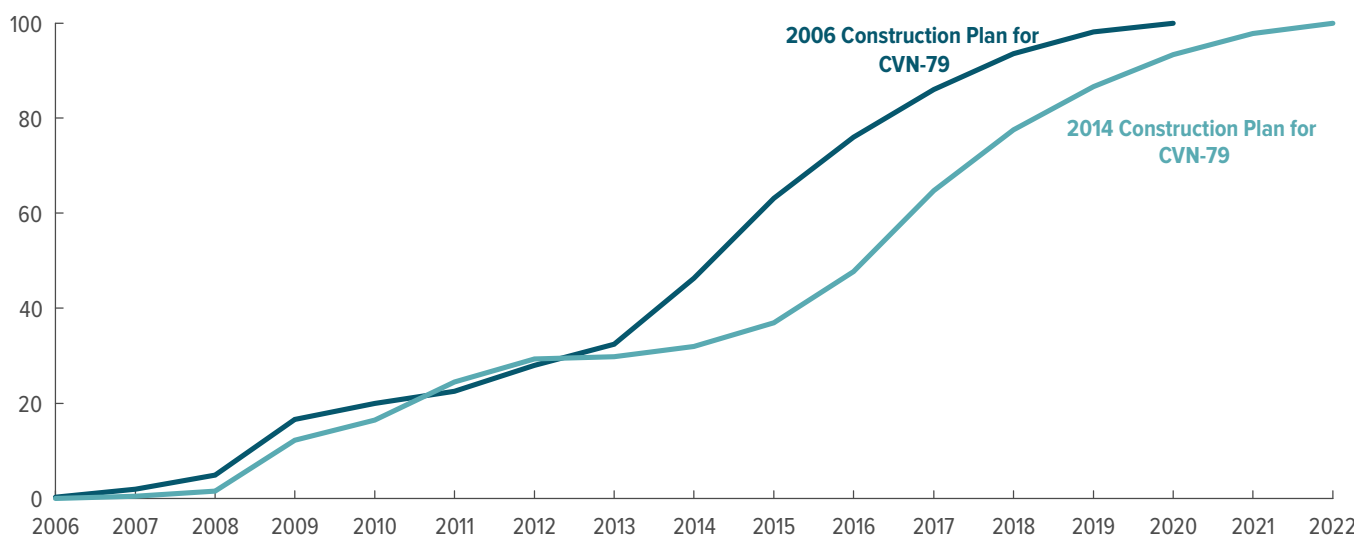
### Design Changes

The final adjustment to the cost cap resulted from what the Navy has stated is additional nonrecurring engineering for design changes that were required to reduce the costs of the second and third ships so that they would fit under the cost cap. That change resulted in an increase of \$325 million that the service charged entirely to the second ship of the class. According to the Navy, the

3. For reasons unrelated to inflation or to the analysis described in this report, the Congress lowered the cap to \$11.4 billion in the 2016 NDAA. CBO does not address that change here.

4. The conference report for the 2016 NDAA indicated that conferees understood that 90 percent of the \$3.4 billion increase was attributable to economic inflation. In CBO's analysis, about 90 percent of the increase reflects a combination of changes related to or affected by inflation: changes in the prices of inputs, the effect on costs of changes in the projected timing of outlays, and the effect on costs of a change in the construction schedule for the second carrier.

Figure 1.

**Cumulative Percentage of Outlays for the Aircraft Carrier *John F. Kennedy***

Source: Department of the Navy.

investment will reduce the procurement cost of all follow-on ships, but CBO did not explore that issue because it was outside the scope of its inflation analysis.<sup>5</sup>

### Analysis of Shipbuilding Inflation

Using the same index the Navy uses for the Ford class aircraft carrier program, CBO was able to replicate the Navy's calculations for inflation in that program. The small difference between projected and actual inflation was attributable to changes in the cost of materials.

### Sources for the Navy's Forecasts of Future Shipbuilding Prices

The Navy uses several data sources to estimate the prices of labor and materials in future Navy ships. For changes in labor prices, the Navy relies on forward pricing rates (commonly abbreviated as FPRs) that the service has negotiated with the shipyards that will build those ships. Those are the prices the shipyards expect to pay their workforce, largely based on the wage agreements that the shipyards, in turn, have negotiated with their employees. The Navy adjusts those wage forecasts from the shipyards to account for issues specific to each yard—for instance, the local labor supply and the effects of various overhead costs associated with labor, such as fringe benefits, health

care, pensions, and other items. The Navy's adjusted estimates also take into account various demographic factors, such as expected changes in a shipyard's workforce, the mix of skilled trades in the shipyard workforce, the balance between new hires and senior employees, and other workforce changes. The result is the Navy's forecast of the cost of labor for each individual shipyard.

To project changes in the prices of materials, the Navy relies on two sources: the material cost estimating relationship (known as MATCER), which is an annual survey of shipbuilding materials that the Navy conducts; and historically based indexes from the Bureau of Labor Statistics, which are used for forecasting price changes in applicable shipbuilding materials. Using those two sources, the Navy projects the prices of materials required in major categories of construction, such as those involving the hull, electrical components, or propulsion systems. Those categories, called the ship work breakdown structure (commonly abbreviated as SWBS), allow the Navy to include cost adjustments unique to the sector—nuclear, nonnuclear, or commercial—to which each ship class belongs. For example, the Navy's materials price forecast for nuclear-powered ships, which include aircraft carriers and submarines, accounts for the smaller, more specialized industrial base for nuclear ships; the higher proportion of ship components that have only one supplier (or so few suppliers that it is difficult to switch to a different one in response to a price increase); and the

5. For a discussion of that issue, see Department of the Navy, *Aircraft Carrier Construction: John F. Kennedy (CVN 79)*, Report to Congress (March 2013).

Table 1.

### Measures of Inflation in the Ford Class Carrier Program, Naval Shipbuilding in General, and the Overall Economy

Percent

	Inflation in the Ford Class Carrier Program		Other Measures of Inflation	
	Inflation Projected in the Fiscal Year 2006 Budget	Actual Inflation	Actual Inflation in Naval Shipbuilding	Actual GDP Price Inflation
2007	4.18	4.30	5.03	2.72
2008	4.18	5.33	4.79	2.07
2009	4.18	3.92	3.22	1.17
2010	4.18	2.93	2.92	0.09
2011	4.18	3.59	3.85	2.03
2012	4.18	3.80	2.97	1.82
2013	4.18	3.86	2.57	1.59
2014	4.18	3.91	2.65	1.53
2015	4.18	3.87	2.48	1.69
<b>Memorandum:</b>				
Cumulative Inflation, 2007 to 2013	33	31	28	13

Source: Congressional Budget Office, using data from the Department of the Navy and the Bureau of Economic Analysis. Projected and actual inflation rates in the aircraft carrier program and in naval shipbuilding more generally were provided by the Department of the Navy. Actual rates of GDP price inflation were obtained from the Bureau of Economic Analysis, National Income and Product Accounts Tables, Section 1, Table 1.1.4: "Price Indexes for Gross Domestic Product" (accessed on April 21, 2016), <http://tinyurl.com/pf5br49>.

GDP = gross domestic product.

relatively small procurement quantities for those ships. (Submarines are purchased at rates of one or two per year, and aircraft carriers are purchased at a rate of one every five years.) The final result is a cost index for materials that is specific to a particular shipbuilding program, in this case, the Ford class carrier program.

#### Comparison of Projected and Actual Inflation Rates

With its submission for the President's 2006 budget, the Navy projected an inflation rate of 4.18 percent per year between 2007 and 2022 for the Ford class aircraft carrier program. Compounding the seven annual increments of inflation from 2007 through 2013 (the period relevant to the adjustment of the cost cap) yields a cumulative projected increase of about 33 percent. In comparison, actual inflation rates for carrier construction were, on average, somewhat below the rates the Navy projected in the 2006 budget. Over the 2007–2013 period, average annual

inflation for carrier construction was 3.96 percent, a cumulative increase of 31 percent (see Table 1). In comparison, inflation in naval shipbuilding generally, and in the economy as a whole, was lower than in the Ford class carrier program.

According to information provided to CBO by the Navy, the difference between projected and actual inflation was caused by lower-than-expected increases in the cost of materials. Specifically, costs for materials grew at an average annual rate of 3.8 percent between 2007 and 2014, compared with a forecasted rate of 4.0 percent over the same period. High growth in commodity prices in 2007 and 2008 contributed to actual inflation rates that were higher than projected, but those higher rates in the early years were more than offset by lower actual inflation after 2009, which was caused by smaller-than-expected increases in commodity prices.

This Congressional Budget Office report was prepared as directed by the conference report accompanying the National Defense Authorization Act for Fiscal Year 2016 (Public Law 114-92). In accordance with CBO's mandate to provide objective, impartial analysis, the report makes no recommendations.

Eric J. Labs of CBO's National Security Division prepared the report with guidance from Matthew Goldberg and David Mosher. Carla Tighe Murray provided helpful comments and fact-checked the document.

Stanley Horowitz of the Institute for Defense Analyses and Edward Keating of the RAND Corporation provided thoughtful review and helpful comments. (The assistance of external reviewers implies no responsibility for the final product, which rests solely with CBO.)

Jeffrey Kling and Robert Sunshine reviewed the report. Loretta Lettner edited it, and Maureen Costantino and Jeanine Rees prepared it for publication. An electronic version is available on CBO's website ([www.cbo.gov/publication/51469](http://www.cbo.gov/publication/51469)).



Keith Hall  
Director



